SCIENCE.

FRIDAY, OCTOBER 16, 1885.

COMMENT AND CRITICISM.

THE INTEREST EXCITED in England by the address of Sir Lyon Playfair before the British association is well shown in the comments of the London press, which are summarized in an article in *Nature* for September 24. The subject of state aid to science has been before the English public for many years, but has never attracted at any time the same earnest and general attention that it has since Sir Lyon Playfair's address. The comments of the London *Times* upon the address probably best show the condition of public opinion upon the question in England. The *Times* acknowledges the reproach that countries less wealthy than England make efforts to encourage science, by the side of which the encouragement afforded in England by the state sinks into insignificance; but it urges that, aside from state aid, there are the large ancient endowments for the benefit of education, which, although they may still be largely misapplied, yet could be used for the encouragement of science if vested interest and lack of intelligent initiative did not stand in the way. The *Times* urges that, until these obstacles are removed by the pressure of an active intelligent public opinion in England, the state itself can hardly be expected to do more than it does.

THERE HAS LATELY GONE THE ROUNDS of the press a description of a meteorite which startled south-western Pennsylvania on September 26. It was reported that it finally struck the earth on the farm of Mr. Buckston, Jefferson township, Washington co., near the West Virginia line. The stone was said to have been broken into three pieces, which became partly buried in the ground. The color was described as gray with streaks of red running over it, and the size of the meteorite was given as from 30 to 50 feet in diameter. The last statement was not, however, received by all as probable. We wish to call attention to a letter in another column, from Prof. S. P. Langley of the Allegheny observatory, who sent one of his assistants to examine into the truth of the reports. It seems that the 'red streaked' meteorite, 50 feet in diameter, is a fiction of the news-gatherers.

TIMING THE FLOOD ROCK EXPLOSION.

HOWEVER successful the explosion at Flood Rock may have been as to its main feature in the removal of an obstruction to navigation, it is to be regretted that one of the minor features of considerable scientific interest should have been seriously interfered with by the blundering delay in the time of firing the mine. At the request of the U.S. geological survey, observers at a dozen or more observatories within 200 miles of New York were watching to note the time of arrival through the ground of the tremors from the explosion, observing in most cases with their meridian-instruments over the mercury nadir-basin, much the most powerful and sensitive apparatus for detecting tremors.

Reports at hand up to time of writing indicate that out of 17 stations (3 occupied by geological survey parties and 14 co-operating with them) 5 hung on till the disturbance came and got more or less satisfactory observations (at one of these the rock was directly in sight, and the others so near that the observers felt sure that it had not escaped them); 4 observed and timed some slight disturbances between $11^h\ 3^m$ and $11^h\ 7^m$, and, attributing them to the explosion, ceased watching for more, and either missed it entirely or were taken by surprise with chronographs stopped, etc.; 2 heard nothing at all up to about $11^h\ 10^m$, and so ceased observing, and missed it; and 6 are yet to be heard from. The observations of those who got any records at all must be considered as due to persistent pluck and good luck rather than the natural and easy result of intelligent co-operation on the part of the army-engineers.

H. M. PAUL.

SCIENCE AND THE STATE.

SIR LYON PLAYFAIR, in his recent address before the British association in Aberdeen, said much that was instructive and suggestive in respect to the progress of science, and the conditions on which it depends; but there is one portion of his address which is entitled to careful perusal, because the speaker is one of the few men in the world who has had the training of a man of science and of a statesman. His early career, as the older readers of *Science* must be aware, was that of a chemist; and of late he has been an active

and influential member of parliament. At one time he held a seat in the cabinet. From both positions, as a savant and as a statesman, he is entitled to speak upon the relations of government to science. It is interesting to note that the principles which he defends were uttered by Prince Albert in his address at Aberdeen in 1859, and long before by George Washington in his farewell address. Prince Albert laid down the doctrine that Science should "speak to the State, like a favored child to its parent, sure of his paternal solicitude for its welfare," and also "that the State should recognize in Science one of the elements of its strength and prosperity, to foster which the clearest dictates of self-interest demand." The words of Washington hardly need to be quoted to American readers :—"Promote as an object of primary importance institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion should be enlightened."

Sir Lyon Playfair goes back to the Greeks and the Arabs, to remind his hearers that in ancient as well as modern times the encouragement of science has been a duty of statecraft, and with many an intermediate allusion he comes to the actual state of affairs in the United Kingdom,—where the working classes now show a respect for science by selecting as their candidates for parliament in the next election such men as Professors Stuart, Roscoe, Maskelyne and Rücker. Playfair has himself received invitations from working-class constituencies in a dozen of the leading manufacturing towns.

In confirmation of the views which he advocates, Playfair refers to the action of France and Germany, and in still more emphatic terms to the practice of the United States. In some respects, he says, this young country is in advance of all European states in joining science to its administrative offices. He points particularly to the excellent work of the U. S. fish commission, and makes this amusing comparison of the English and American methods of promoting fisheries. In England there are expensive commissions to visit the coast and question the fishermen; and the fishermen, having only a knowledge of a small area, give the most contradictory and unsatisfactory evidence. "In America, the questions are put to nature and not to fishermen,"—and the results of the inquiry are therefore far more fruitful. In this bright antithesis—questioning nature, not the fishermen—there is a ready answer to those who wish for 'practical' science, not abstract science. It seems 'practical' to question fishermen; the process proves to be fallacious. It seems 'abstract' to question nature; but this method is found to be the surest road to positive knowledge, and hence to the best results.

THE EXPLOSION AT FLOOD ROCK.

THE scientific as well as the general public has felt no little interest in the explosion which occurred on last Saturday at New York, through the effects of which one of the most dangerous obstructions to the East River passage was so altered in its conditions as to be removable in the near future. The destruction of Hallett's Point reef in 1876 was a notable exhibition of engineering skill in the use of explosives, and by its complete success gave confidence to General Newton and his aides in their attack upon Flood Rock, which, in the area undermined and in the amount of explosive material made use of, far exceeded the reef at Hallett's Point. The methods of procedure in the latter case were, in general, similar to those of the former, the two operations differing more in magnitude than in anything else.

On the occasion of the explosion of 1876 it was observed that, although in the immediate vicinity of Hallett's Point no very violent or destructive disturbance took place, the resulting earth-tremor was noticeable over an area several miles in radius. Some observations were made at that time to determine the velocity of transmission of the seismic wave, under the direction of General Abbott of the Engineer corps. The results obtained indicated a much greater speed of transmission than had been previously admitted for such disturbances, and they received considerable criticism at the hands of well-known seismologists. The explosion of last Saturday offered an opportunity for a repetition of these experiments on a greater scale and under circumstances much more favorable, as it was fair to assume that the earth-tremor would be perceptible at a much greater distance from the origin of the disturbance, and that thus not only would certain errors of observation become of less importance, but any marked variation of velocity with distance would be detected.

A line of points for time observations was established by General Abbott on Long Island, which were connected, it is understood, with each other and with the point from which the mine was fired, by telegraph.

As stated in the last number of this journal, arrangements to secure observations were made by

the U. S. geological survey, together with representatives from the naval observatory and the signal service. Although the results of this work cannot be definitely ascertained for at least some weeks, the readers of *Science* will doubtless be interested in a brief account of the methods of doing it.

Doubtless the most certain method of detecting slight earth-tremors is by means of a vessel of mercury, from the surface of which is reflected light from a series of pin-holes in an opaque sheet of metal or card-board, the image of the holes being observed and studied by means of a telescope properly secured against accidental disturbances. The slightest ripple in the mercury produces a blurring of the image of the small pinholes. Of course in an astronomical observatory the reflected image of a star or of illuminated micrometer lines will be equivalent to the above arrangement, and in some respects superior to it. By increasing the magnifying power, the sensitiveness of this method of observation may be increased almost indefinitely, easily being carried beyond what is desirable. A serious objection to it, however, is that the disturbance makes no record of itself, requiring, therefore, constant attention from the observer during the entire period covering the possible arrival of the wave to be detected. The great convenience of the method and the ease with which it can be used at most astronomical observatories, taken in connection with its great sensitiveness, justified the sending of circulars inviting co-operation to directors of observatories within the possible radius of appreciable disturbance. These were issued a week before the explosion, and, on the night previous to its occurrence, telegrams were sent to those who had indicated a disposition to co-operate, informing them of the exact hour fixed for the event.

The party proceeding from Washington, consisting of Professor F. W. Clarke, Professor H. M. Paul and the writer, in addition to being provided with the necessary apparatus for mercury observations, carried three seismoscopes and one chronograph, together with a number of chronometers.

The seismoscopes were of a form recently designed in the physical laboratory of the U. S. signal service, and were constructed by Mr. Kübel, the mechanician of the geological survey. They were hastily prepared for this expedition, and have not yet quite reached their final form, but a brief description of one may be of interest.

A steel wire about two millimetres in diameter is bent so as to form a loop at the end about eight cm. in length and twelve mm. in breadth, the sides parallel and the ends round ; from one end a long needle of the same wire projects, its length being three or four times that of the loop, and its point very sharp. A cylindrical iron weight, of one or two kilos, has a hole drilled through it along the axis, large enough to freely pass the looped end of the needle, one part of this hole being of somewhat smaller diameter than the other. A small circular steel plate, with opposite sides cut away, fits the larger bore and rests on the shoulder of the smaller. Through the centre of this plate a steel screw passes downwards, the point of which rests in a small cup made in the centre of the round end of the loop, from which the needle projects. The upper end of the loop reaches a short distance through the cylindrical weight, and hangs upon a small hook rigidly secured to the cast-iron support. When in position, the steel points, on which the weight is supported, are sufficiently above the centre of gravity to insure stability. It is easily seen that this point is approximately that about which instantaneons rotation of the needle takes place when the system is slightly disturbed, and that any motion of the sustaining hook is greatly magnified at the point of the needle. Just below the latter is a sort of lever-trigger, moving freely about a horizontal axis, from the short end of which projects in a vertical direction a very fine wire two or three mm. in length. To the long arm of the lever is fastened a platinum wire shaped like an inverted U, with the legs resting in mercury cups. The instrument is 'set' by lifting the long arm until the fine wire at the end of the short arm rests on the point of the projecting needle, in which position it remains with the platinum wire out of the cups and the circuit broken. A slight jar produces motion in the needle, releasing the short wire and allowing the long arm of the lever to drop and close the circuit. The instrument may be made as sensitive as is desired by diminishing the size of the needle point and of the small wire which rests upon it. The advantage of an instrument of this kind is obviously its automatic operation. It can be joined up with a chronograph and left to register its drop without further attention.

One of these seismoscopes was thus connected with a chronograph in the basement of one of the buildings belonging to the Emigrant's hospital on Ward's Island. No better point could have been found, as it was in full view of and almost the nearest point on land to Flood Rock. The writer must express his indebtedness to Dr. Marple, the physician in charge, and to others connected with the hospital, for the generous manner in which all facilities at hand were placed at his disposal in the arrangement of this station. A mercury observa-

tion was also made at this place and a stop-watch record was taken by Professor Clarke.

Professor Paul established himself with a mercury apparatus on Staten Island, about fifteen miles away. Professor Hallock, of the geological survey, who joined the party at New York, occupied a station at Yonkers, distant about ten miles, where he was fortunate in securing the co-operation of Mr. Thomas Ewing, Jr., of Columbia college. Mr. Hallock observed with a mercury apparatus and chronometer; and Mr. Ewing used a seismoscope, noting the time of the 'drop' by a stop watch. Professor Rees of Columbia entered enthusiastically into the work, and used a seismoscope with a chronograph and a mercury apparatus with chronometer at the college observatory. It was planned to place an observer at the meteorological observatory in Central park, opportunity for which had been kindly offered by Dr. Draper, but at the last moment no one was available for that point. Dr. Draper, however, made a number of interesting observations on the behavior of his self-registering meteorological instruments, getting a record of the shock from nearly all of them. Astronomical observatories in the vicinity of New York had been notified; and, in a number of them, observers were anxiously awaiting the appearance of the ripple on the surface of the mercury.

Unfortunately the firing of the mine was delayed nearly fourteen minutes. This, however, did not prevent good observations at several points. From Ward's Island the movements of the men on Flood Rock were easily noted, and the observer was not obliged to begin his watch until the last steamer had left the rock, and it was known that the explosion could be expected very soon.

It is impossible to describe the appearance of the river an instant after the mine was fired. A mass of water covering several acres seemed to have been instantly lifted to a height variously estimated at from one hundred to two hundred and fifty feet. It has been several times described as resembling a gigantic iceberg; and for a moment no more fitting term could have been applied. The seismoscope left its record of the initial disturbance on the chronograph sheet, and behaved throughout in a most satisfactory manner.

At Yonkers, in spite of a prolonged observation, covering about eighteen minutes, the wave was 'caught' by both the mercury dish and the seismoscope, the times observed agreeing within one-fourth of a second. The seismoscope used by Professor Rees and his assistant, Mr. Jacobi, at Columbia college, recorded the passage of several railway trains before the explosion occurred; but it was always reset, and did its work promptly when the time arrived. The long delay was the cause of a failure at the Staten Island station, occupied by Professor Paul. He recorded in his notebook a disturbance of the mercury at about three minutes past eleven, but expressed his doubt as to its being due to the explosion. After waiting six or eight minutes, he decided that this disturbance was genuine, or that the explosion had occurred and had failed to reach him, and ceased his observations. It is greatly to be regretted that a record was not secured on Staten Island, as it would unquestionably have been, had the event occurred within a reasonable limit of the moment previously fixed. Observers at astronomical observatories away from New York have not yet been directly heard from, but it is feared that the delay of fourteen minutes prevented observations being made at many points where the wave might be expected to make itself felt. The telegraph reports an observation at New Brunswick, which was doubtless, like Professor Paul's, due to some other cause, and which prevented the observer from afterward getting the true wave. But report comes in the same way that Professors Young, Rockwood, and McNeill, were entirely successful at Princeton. Altogether it is believed that a sufficient number of reliable observations will be reported to be of great value, and the results of their reduction will be looked for with much interest.

It is not likely that another opportunity of this kind will occur in the near future; but from the experience of this occasion it is easy to see the importance of having the origin of the disturbance surrounded by a considerable number of stations at varying distances, at each of which a seismoscope with chronograph is used, so that where possible the record may be automatic; and it would also be extremely desirable to arrange that those in charge of the firing should agree to some plan, by means of which if the explosion did not occur at a definite hour previously announced, it should be postponed for ten minutes, and if not then ready, for another ten, and so on. In this way observers at a distance would be almost certain of success.

It ought to be added that the work of planning and arranging for the observations above noted was necessarily hurried, that it was undertaken and carried out under circumstances by no means favorable, and that it falls far short of what was desired and hoped for by those engaged in it.

T. C. MENDENHALL.

DISINFECTION.

DISINFECTION consists in the destruction of something infectious, and we fail to see any justification for the popular use of the term which makes

it synonymous with deodorization. From our point of view the destruction of sulphuretted hydrogen, or of ammonia, in a privy vault is no more disinfection than is the chemical decomposition of these gases in a laboratory experiment. But when we destroy the infecting power of vaccine virus, or of the blood of an animal dead of anthrax, we disinfect this material no matter where it may be. "There can be no partial disinfection of such material; either its infecting power is destroyed or it is not. In the latter case there is failure to disinfect. Nor can there be disinfection in the absence of infectious material" (Preliminary report of committee on disinfectants of the American public health association).

Using the term then, in this restricted and scientific sense, what tests have we of disinfection, and what are the best disinfectants? The evidence of disinfection must evidently be based upon experiments which show that the infectious material has lost its specific infecting power. Such evidence we obtain from three sources: (*a*) practical experience in the use of disinfectants; (*b*) inoculation experiments upon susceptible animals; (*c*) biological experiments upon pathogenic micro-organisms—the test being failure to multiply in a suitable culture-medium after exposure to the disinfecting agent in a given proportion for a given time.

Until guided by exact data obtained in the laboratory the progress of our knowledge relating to disinfection was slow and uncertain. While agents now recognized as efficient were frequently resorted to in the pre-scientific period, they were often used by the sanitary authorities of the day in amounts entirely inadequate for the accomplishment of the object in view; and for the vulgar a disinfectant was a charm which was supposed to exorcise the disease-producing agent in some mysterious way. We must accord a certain value to the experiments of sanitarians in their efforts to restrict the extension of infectious diseases, although the evidence of successful disinfection offered by 'practical' men will not always stand scientific criticism. When a house in which a case of small-pox has occurred is fumigated with sulphurous acid gas, and this fumigation is followed by a thorough cleaning up, a liberal application of whitewash, and vaccination of everyone in the vicinity, it must always remain a matter of doubt whether the small-pox infection was, or was not, destroyed by the fumigation. In experiments made in practice—either clinical or sanitary—we have rarely any comparative test, and an undue value is often accorded to negative evidence. Laboratory experiments are, therefore, essential as a check upon 'experience,' and as a guide for successful practice.

Many experiments have been made directly upon infectious material, without reference to the exact nature of the infectious agent present in this material—the test of disinfection being failure to infect susceptible animals after treatment with the disinfecting agent. Of this nature were the experiments of Davaine upon the blood of animals dead with anthrax, or with infectious septicaemia; of Baxter and of Vallin upon the virus of glanders; of the writer upon septicaemic blood; and of numerous observers upon vaccine virus. The experiments upon dried vaccine—upon ivory points—are among the most satisfactory of these; for the inference seems to be quite safe, that whatever will destroy the specific infecting power of this material will also destroy the small-pox virus. The writer's experiments (1880) show very conclusively that chlorine and sulphurous acid gas are agents which may be relied upon for the destruction of the infecting power of this material—due regard being paid to the necessary conditions relating to quantity and time of exposure.

Since it has been demonstrated that the infecting power of certain kinds of infectious material is due to the presence of micro-organisms, numerous experiments have been made to determine the exact germicide power of a variety of chemical agents, as tested by these demonstrated disease-germs, and by non-pathogenic organisms belonging to the same class. These experiments show that, while the resisting power of organisms of this class differs within certain limits, in the absence of spores, a germicide for one of these organisms is a germicide for all. There is a wide difference, however, between the resisting power of spores, and that of bacteria in active growth. The growing plant—micrococcus, bacillus, or spirillum—is quickly destroyed by a temperature of from 150° to 160° F., while the spore resists a boiling temperature for several hours. Carbolic acid (2% sol.), sulphate of copper (1% sol.), and various other agents which are efficient for the destruction of active bacteria, fail in concentrated solution to kill spores. The experimental evidence on record indicates that the following named disinfectants are the most generally useful, from a practical point of view:—

Moist heat. A boiling temperature quickly destroys all known pathogenic organisms in the absence of spores. A temperature of 230° Fahr.—steam under pressure—maintained for ten minutes, will destroy spores.

Chloride of lime. A four per cent solution quickly destroys all micro-organisms, including spores. Labarraque's solution (liquor sodae chlorinatae) is equally efficient when of corresponding strength.

Mercuric chloride, in aqueous solution, in the proportion of 1: 10,000, is a reliable agent for the destruction of micrococci and bacilli in active growth, not containing spores; in the proportion of 1:1,000 it destroys the spores of bacilli, when they are fairly exposed to its action for a sufficient length of time (two hours).

Carbolic acid cannot be relied upon for the destruction of spores. This agent is recommended by Koch for the disinfection of the excreta of patients with cholera (5% sol.). A two per cent solution may be used for disinfecting clothing, etc.

Sulphate of copper is largely used as a disinfectant in France. It is efficient in the proportion of one per cent for the destruction of micro-organisms without spores; for excreta, use a five per cent solution.

Sulphurous acid gas is the most useful gaseous disinfectant, and is mainly relied upon for the disinfection of ships, hospital wards, etc. It is important for the destruction of spores, and exact experiments show that its disinfecting power, as determined by biological tests, has been very much over-estimated. For details, with reference to the germicide power of this and other disinfectants mentioned, the reader is referred to the preliminary reports of the committee on disinfectants of the American public health association, published in the *Medical news*, Philadelphia (Jan.–July, 1885).

GEORGE M. STERNBERG.

LIFE OF AGASSIZ.

IT is nearly twelve years since Agassiz died. Many tributes to his life have appeared in the meantime, the best of them being a memoir by his life-long friend, Guyot, which was communicated to the National academy of sciences. Now come his memoirs, edited (as the title page modestly expresses it) by his widow. Mrs. Agassiz was the person of all others best qualified for this work. Her entire familiarity with the scientific pursuits of her husband, her participation in his long journeys, her excellent style as a writer, and her calm and well controlled enthusiasm have enabled her to produce a volume which must give satisfaction to every one. She has avoided two obvious dangers, that of describing too minutely the incidents of domestic life, and that of leading the uninformed into the depths of zoölogical learning. She has drawn a portrait of the great naturalist,—let us rather say she has drawn a series of portraits, taken at different periods of life and in different attitudes, so that the man himself is before us, as the devoted student of nature, the brilliant lecturer, the correspondent of eminent men in every land, the good citizen, the bright companion, the hearty friend, the wonderful teacher.

The first of the two volumes is devoted to the European life of Agassiz, with which Americans generally are less familiar, and the second to his American career, which is not so well known in Europe. The proportions of the narrative are well preserved, and upon those who knew Agassiz well, and upon those who knew him only by name the same effect will doubtless be produced. As they read these pages they will see the man. He will appear as a personal and, perhaps, as a familiar acquaintance, returned once more to the scenes from which he has departed, and ready to open the stores of his memory, of his correspondence, and of his museums, to our eager attention. We have rarely, if ever, read a biography which brought the subject so vividly before the reader in the lineaments of life. One of the most charming chapters in the book is the first on the boyhood of the naturalist: it gives the key to all that is subsequent. We are here introduced to the parsonage at Motier, with its view of the Oberland, its garden and orchard with unblemished apricots, and its great stone basin into which a delicious spring was always pouring the water for Agassiz's first aquarium, and to the wise and discerning mother who understood that her boy's unusual love of nature was 'an intellectual tendency' to be developed by her aid, and who remained until her death—only six years previous to that of her gifted son—'his most intimate friend.'

From his earliest days onward, Agassiz's love of natural history was manifested: birds, field mice, hares, rabbits, guinea pigs and fishes were collected and studied. All sorts of handicrafts were also practised, and the future naturalist was not a bad tailor, cobbler, carpenter, and cooper. He acknowledged through life that his dexterity was largely due to these half sportive and half earnest pursuits of his childhood. At ten years of age he began his school life at Bienne, twenty miles from home, and there, during a period of four years, he received good training in Greek, Latin, French and German, and in various branches of natural science. A letter which he wrote at fourteen, showing what books he feels in need of, is a remarkable sign of his intellectual aspirations. During the next two years at Lausanne, he found a sympathetic teacher in Chavannes, who possessed the only collection of natural history in the Canton de Vaud, and a good counsellor in his uncle, Dr. Mayor, a physician of note, who

[1] *Louis Agassiz, his life and correspondence.* Edited by ELIZABETH C. AGASSIZ. Boston. *Houghton, Mifflin & Co.*, 885. 2 vols. Illustr., portr. 12°.

advised the boy to abandon the thought of a commercial life, toward which he had been pointed, and in place thereof, to prepare for the medical profession. Two years were next spent in Zurich; and at the age of nineteen Agassiz was enrolled at Heidelberg. Several letters pertaining to this period are given. Here it was that by the introduction of Tiedemann, he became acquainted with one of the most valued friends of his whole life, Alexander Braun, afterward director of the botanical gardens in Berlin. "Braun learned zoölogy from Agassiz, and he in his turn learned botany from Braun;" and so it came to pass that through life "Braun knew more of zoölogy than most botanists, and Agassiz combined an extensive knowledge of botany with that of the animal kingdom." Karl Schimper was another friend of this period. Leuckart and Bischoff were his favorite teachers, but Tiedemann, Braun, and Nägeli were also valued instructors. We do not recall in biographical literature a more interesting account of the development of a naturalist's youth than is given in this opening chapter. Every teacher of boys ought to read it, for it illustrates the importance of discovering the bent of a young mind, and of affording it the requisite opportunities.

A far more stimulating life than that at Heidelberg awaited Agassiz, Braun, and Schimper in Munich, where Dollinger, Martius, Schelling, and Oken, were among their eminent teachers. For this period Mrs. Agassiz has brought together the letters interchanged between the student and his circle at home. Nothing could be better than the glimpses which they afford of the university influences surrounding a youth of twenty-one, in vacation and in term-time. 'The little academy' which was constituted by Agassiz and his comrades, has become historical. But more interesting than anything else in this part of the memoir is the draft of a letter from Agassiz to Cuvier, which has been preserved, although nobody can now tell whether it was actually sent to the eminent man in Paris, whom Agassiz wished to consult with reference to his future career. He tells what he has done and what he wishes to do, and he brings his confession to a close in these words:— "I seem to myself made to be a travelling naturalist. I only need to regulate the impetuosity which carries me away. I beg you then to be my guide." If Cuvier did not receive this letter, he did receive the work on Brazilian fishes dedicated to him by Martius and Agassiz, and his acknowledgment is preserved and printed. The story of Agassiz's youth is brought to a close by an autobiographical sketch which he once dictated, and "which forms a sort of summary of his intellectual life up to this date."

The next chapter tells of his actual acquaintance with Cuvier and his prosecution of the study of natural history in Paris under great pecuniary limitations and anxieties. Here we read the romance of education. One day Cuvier asked Agassiz to do something, saying, "you are young; you have time enough for it; and I have none to spare." This task proved a legacy. They worked together till eleven o'clock, when they paused for breakfast; and then resumed their occupations until dinner-time, when Agassiz excused himself. Cuvier told him that he was quite right not to neglect his regular hours for meals, and commended his devotion to study, but he added, 'Be careful and remember that *work kills.*' "They were the last words Agassiz heard from his beloved teacher. The next day, as Cuvier was going up to the tribune in the Chamber of deputies, he fell, was taken up paralyzed and carried home. Agassiz never saw him again."

With Humboldt, as well as with Cuvier, Agassiz became acquainted in Paris, and was greatly encouraged by his friendliness. Offers were made to Agassiz to remain in Paris, but Humboldt advised him to accept a professorship in Neufchâtel. This he did in 1832, when he was twenty-five years old, and then his independent life began. Teaching became "a passion with him, and his power over his pupils might be measured by his own enthusiasm." "From the beginning his success as an instructor was undoubted." "The little town suddenly became a centre of scientific activity," and the young professor's name was so favorably known that he was soon called to a chair in Heidelberg, which he could not make up his mind to accept. In 1833, he married Cecile, the sister of Alexander Braun.

During the ten years following (1833–1843) Agassiz was engaged upon the great work of his early life, the 'Researches on fossil fishes.' Offers of coöperation came to him from noted investigators, and he was known in all the museums of Europe as an indefatigable worker and collector. The first American subscriptions to his great work were received through Benjamin Silliman; in Germany, Humboldt continued to be his adviser and friend; the Wollaston medal was awarded him in London. In 1836, 'a new and brilliant chapter of his life was opened,'—the researches upon glacial action,—and he presently startled the Helvetic association "by the presentation of a glacial theory in which the local erratic phenomena of the Swiss valleys assumed a cosmic significance."

Agassiz was now driving all his steeds abreast; besides his professorial duties he was printing his 'Fossil fishes,' his 'Fresh water fishes,' and his

investigations on fossil echinoderms and mollusks,—all requiring the most careful illustrations. His researches upon glaciers also occupied a great deal of his thought and time between 1836 and 1846. Desor coöperated with him, and so did Arnold Guyot, the acquaintance of his boyhood, the colleague of his middle life, and the friend of his advancing years. In the winter of 1840 the 'Études sur les glaciers' were prepared for publication. The memoir introduces the fascinating story of the 'Hôtel des Neuchâtelois,' and the observations of Agassiz, Guyot, Desor, Vogt, Pourtàles, Nicolet, Coulon and others, and it closes with an account of the ascent of the Jungfrau, by Agassiz, with his five friends and six guides.

About the year 1842, the thoughts of Agassiz turned toward the United States as a region to be studied. Charles Bonaparte, Prince of Canino, was expecting to make the journey and desired to secure his company; but the plan fell through, and in the following spring Agassiz raised this significant question; "Do you think any position would be open to me in the United States where I might earn enough to enable me to continue the publication of my unhappy books, which never pay their way because they do not meet the wants of the world?" Two years later the king of Prussia granted him 15,000 francs for his journey. He sailed for America in September, 1846. Little did he or his friends suppose that he was to make a permanent home in America. "So closed this period of Agassiz's life. The next was to open in new scenes and under wholly different conditions," to which the second volume introduces us.

We have purposely devoted the most of our space to the European portion of this memoir, because the later years of Agassiz's life are so familiar to American readers. We now turn to the second volume, which exhibits the same editorial tact, the same skilful selection and presentation of materials, as the first, and doubtless to many readers it will be more entertaining.

Agassiz first came before the public in this country when he delivered a course of lectures at the Lowell institute. The memoir gives a long letter which he addressed to his mother in December, conveying his impressions of American science and American scientific men, and particularly his observations on a journey from Boston to Washington. Silliman, Dana, Shepard, Gray, Redfield, Torrey, Morton, Lea, Haldeman, Bache, Bailey, Baird, LeConte, are among the familiar names of those whom he met in travel. Another familiar letter to Milne-Edwards gives his impressions of other men and other phases of scientific activity. To Elie de Beaumont he writes of the glacial drift in New England, a problem which always arrested the attention of his practised eye. To oceanic studies he was introduced by the opportunities afforded him on the steamer Bibb, of the U. S. coast survey, through the enlightened invitation of Dr. Bache and Captain Davis. "Here," says the biographer, "was another determining motive for his stay in this country. Under no other government, perhaps, could he have had opportunities so invaluable to a naturalist."

The political revolution of 1848, which released Neufchâtel from the sovereignty of Prussia, released Agassiz from the service of the King of Prussia, and made him free to accept the overtures of a professorship in the Lawrence scientific school of Harvard college, then about to be established, where he was guaranteed a salary of fifteen hundred dollars, until the fees of the students should be worth twice that, a period 'which never came.' The memoir gives a delightful picture of the society of Cambridge in those days, and of the household arrangements, over which an old Swiss friend, 'Papa Christinat,' presided. Then began, 'in an old wooden shanty set on piles,' which might have served as a bathing or boat house, that museum which has grown by the united labors and the devotion of father and son, to be the great Museum of comparative zoölogy in Cambridge. His second marriage took place in 1850, and from that time on Agassiz was identified with the United States. No offers, however tempting, could induce him to give up the delightful circle to which he was bound in Cambridge and Boston.

His scientific journeys to Florida, to Lake Superior, to Brazil, and finally around Cape Horn to California, are so well known to naturalists that we only allude to them. His participation in scientific assemblies; his interest in science-teaching in common schools; his power in developing the school of naturalists now leading in so many branches of science throughout this country; his attractiveness as a public lecturer; his magnetism as a collector; his wonderful beginning of the 'Contributions to natural history;' his hearty friendship; his devotion to his adopted land; his desire to contribute in every way to the good of the public;—all these characteristics are so fresh in the recollection of Americans that they will turn with great delight to the pages in which the details are beautifully brought out.

These volumes deserve to be read by all who are interested in the development of a noble and completed life, which was marked, as the biographer says, by rare coherence and unity of aim.

ASTRONOMICAL NOTES.

AN important series of observations upon terrestrial refraction is reviewed in the *Bulletin astronomique* for August. They were made at Pulkowa upon three signals in the plain below, whose distances were about 12, 5, and 2 km., with zenith-distances of about 90° 17′, 90° 36′, and 91° 5′. They are very completely discussed as regards temperature, steadiness of images, clear and cloudy sky, hour-angle of sun, etc.; but the most remarkable feature is the persistent negative refraction for the nearest station, under all circumstances, the same for the middle station at temperatures much above the freezing point, and the wide departure of all the observed refractions from those given by standard formulæ. The certain indication of a maximum density of the air at some distance above the ground (due probably to rapid fall of temperature in rising from the latter) deserves further investigation at the hands of geodesists, and astronomers as well, for the latter cannot be assured that their observations, especially at considerable zenith-distances, may not be affected by such abnormal density of strata immediately overhead.

The observation of the spectrum of the new star in the nebula in Andromeda—a matter of the greatest importance—seems to present considerable difficulties. By many observers the spectrum has been pronounced continuous. Dr. Huggins, however, observing on September 9, feels confident of from three to five bright lines between D and *b*. Dr. Vogel notes that the intensity of the colors is somewhat different from ordinary star spectra, and he suspects a dark band on the border of the yellow and green, and a second in the blue between F and G. Dr. von Konkoly of the O'Gyalla observatory, considers the spectrum as belonging to Type III. *b*. He found in the red, yellow, green and blue what seemed to be bright bands on a dark ground. If this suspicion is confirmed, these broad, bright bands would correspond to the hydrogen lines C and F, and to the line D_3, and they would also indicate a very great pressure.

A telegram from the Harvard college observatory announces the discovery by Palisa of a 13th mag. asteroid, which may perhaps be Eudora, which has not been observed since its discovery-opposition in 1880. If it turns out to be a new one its number will be 251. It seems that Palisa discovered 250 while hunting for Rhodope 166, which has only been observed at two oppositions, though the present is the sixth since its discovery. If the Vienna 27-inch refractor is to be given up to asteroid discovery, it is to be hoped that it will be the search for old missing numbers rather than new and faint bodies, which, though easy objects in a 27-inch, would be beyond the reach of any but a few of the largest instruments, and they are generally devoted to more important work.

The late discussion as to the identity of Biela's and Denning's comets (*Observatory*, 1885, pp. 257 and 306), in which it is supposed that violent perturbation by the earth threw Biela into the orbit of Denning at the time of the great meteor-shower of 1872, November 27, would seem to be disposed of in the *American journal of science* (xxx., 322), where it is shown that, in such case, the radiant-point of Biela must have been swung round about 125° or 130°, which would call for an approach to the earth's centre nearer than 4,000 miles. On the hypothesis of identity, then, the comet must have gone *through the earth* somewhere.

NOTES AND NEWS.

THE third international geological congress held in Berlin at the close of last month had an attendance of 239 members, of which three-fifths came from Germany. The next largest number (18) came from Italy, and the United States came, with Belgium, sixth on the list—Canada was not represented. Among those present from the United States were Professors James Hall, Newberry, Brush, H. S. Williams and Dr. Persifer Frazer.

— The superintendent of the geological survey of India gives an account of two meteorites, which are the first that have been examined under the recent order of government for the collection and examination of these objects. One fell on Feb. 9, 1884, at Pirthallee, in the Punjab; the stone was received in three pieces, weighing in all 1160.5 grammes, the specific gravity being 3.40; the shape was roughly cuboidal with rounded edges and indented sides. The other stone fell at Chandpoor last April, it weighed 1201.3 grammes, its specific gravity being 3.25, its shape being roughly cuboidal with rounded edges.

— We learn from the London *Engineering* that a short time ago a citizen of Boston, while on a visit to England, examined the map which accompanied the charter of the original Massachusetts Bay company, which formed the patent under which English settlements were originally made, and was surprised to see that the eastern boundary was defined by a line drawn from Hull at the southern extremity of Boston harbor to Nahant, a peninsula on the north. Now a rocky island of small dimensions, known as Middle Brewster, lies to the east of this line, and as the colony of Massachusetts never claimed it or

exercised any authority over it, the island was not included in the revolution of 1776. Has the jurisdiction of Great Britain lapsed in course of years? and if it has not, what are the dozen acres of rock worth? At present it is occupied by a few fishermen, and also contains the summer residence of a Boston attorney, who evidently knows the value of peace and quietness as well as that of nine points of the law.

LONDON LETTER.

THE health of the president of the Royal society, Professor Huxley, is a matter of grave anxiety to his numerous personal and scientific friends. The prolonged absence from work in the winter and early spring of this year failed to restore him to anything like his usual vigor, and last summer he judged it prudent to resign altogether most of his public appointments, especially those in connection with the teaching at the science schools, South Kensington. Whether he will retain the presidency of the Royal society is as yet undecided. As the official representative of the society, and indeed of science generally on all public occasions, the social claims upon him at these public appearances are very considerable. The amount of personal attention that has to be given by the president to work which makes no show is also very large, and more than one past president has had to resign the office on this account. At this crisis, therefore, a grave responsibility is cast upon the council and officers. It has been suggested that Professor Huxley should return with Professor Marsh, of New Haven (who is now on his way to Berlin, having attended the British association meeting), and should remain with him for a year, quietly working through his wonderful collection of dinosaurians. The interest of this to Professor Huxley could not fail to be great, as his forecast about twenty years ago of the probable course of geological discovery with regard to this great group has always been regarded as one of the most sagacious divinations of modern times.

Next to the president of the Royal society, the president of the British association for the advancement of science occupies the representative position above referred to. In this case, however, the *personnel* is changed every year. The appointment of Sir William Dawson, principal of McGill college, Montreal, to this distinguished position for the year 1886–87 (September to September) is a graceful recognition of the part which he took in promoting the most successful visit of the association to that city last year. He will succeed Sir Lyon Playfair, whose life-long labors on behalf of the higher scientific education found a natural expression in his recent presidential address at the Aberdeen meeting. One of the most remarkable features of this was the evidence it gave of the extent and variety of its author's reading, no less than sixty references being made in it to various books. Advocating as he did a greatly-increased expenditure on education in pure science, his address has been sharply criticised by those organs of the so-called 'practical men,' to whom everything that savors of the 'endowment of research' is as a red rag to a bull.

Next month will be a time of great political excitement in the United Kingdom, in consequence of the first elections of members of parliament by the new constituencies, created by the recent Reform act, the total number of votes having been increased by two millions. Signs are not wanting that science will be much more largely represented in the new parliament than it ever has been before. Sir J. Lubbock and Sir Lyon Playfair have hitherto been the two chief men to whom the house has looked for counsel and advice in scientific matters. It is expected that the distinguished chemist, Sir Henry Roscoe, will be returned for one division of Manchester, and that Professor A. W. Rucker, late professor of physics in the Yorkshire college, will be returned for one division of Leeds. Several other men of more or less scientific reputation are mentioned as possible candidates in connection with various constituencies.

The condition in which the river Lea has been during the last few months is one which illustrates the need of more scientific knowledge on the part of the legislature. This is a comparatively small river in the north-east of London, from the upper part of which one of the eight water companies which supply the metropolis with water is permitted by acts of parliament to pump daily large volumes of water. By other acts of parliament the suburbs of London (Tottenham, etc.), which in course of time grew up upon its banks, were permitted to pour their sewage into it at a point considerably below the intake of the water company. Of late years the enormous growth of London has practically rendered these suburbs a part of the metropolis itself. The neighborhood is a comparatively poor one, and the river and its banks used to be one of the most important recreation grounds in that district, boating, angling, etc., being freely indulged in. In consequence, however, of the diminution of the flow of water below the company's intake and the increase in the sewage, both of which are authorized by act of parliament, the condition of this part of the river during the past summer can only be likened, with justice,

to that of an open sewer. Several large indignation meetings have been held, as well as demonstrations of unemployed boatmen, etc.; and deputations have waited upon the Home secretary, but all to no purpose; this high official practically declared himself powerless to act, in consequence of the sanction of the law having been extended to both proceedings. On one Sunday during the warm weather, when the condition of the river became practically unbearable, the water company, yielding to strong representations made to them by medical men and others, raised its sluices and allowed the whole volume of the river to flow along its natural course. This produced a partial and temporary mitigation of the evils complained of at a considerable loss to the shareholders. Fortunately the summer heat has passed without serious outbreaks of illness in the neighborhood, but meantime the deadlock continues, and apparently will continue, until the new parliament reverses one or other of the decisions of its predecessors.

The condition of the Thames itself is an illustration on a large scale of the results of the same legislative action, and has been the subject of investigation recently by a royal commission. The Metropolitan board of works is the body charged with dealing with the sewage of London as a whole. At present the sewage of London is discharged into the Thames mainly at two points some miles below London bridge, one on the north and one on the south bank of the river. The latter station, called Crossness, which receives all the sewage from the Surrey side of London, was visited by the present writer, in company with several other members of the Society of chemical industry, last July; the object of the visit was to see the measures which had been taken by the board for the purpose of diminishing the nuisance caused by the sewage discharge at this point. For a considerable period on either side of low-water the sewage can be pumped direct into the river, but at other times it has to be pumped into huge covered reservoirs, which are allowed to empty themselves at low tide. The ameliorating measures consisted in running into the sewage during its discharge a solution of sodium manganate, mixed with a quantity of sulphuric acid supposed to be sufficient to decompose the sodium salt, liberating a solution of manganic acid. The sodium manganate was manufactured on the premises by fusing caustic soda (of which there was a large stock on the ground) with black oxide of manganese. The inefficiency of the process adopted, to do any real good, as well as its great cost, was somewhat freely commented on by the visitors, as well as the crude manner in which all operations were carried out. Several schemes are before the public for dealing with the sewage of the north bank of the river, some of which involve the use of Canvey Island, a large low-lying tract of land in the estuary of the Thames, where probably sewage irrigation could be carried out on a very large scale. We may perhaps recur to these in future letters.

The Society of chemical industry, before referred to, has just sustained a severe loss in the sudden death of one of its most active founders and past presidents, Mr. Walter Weldon, F.R.S. Wherever the manufacture of soda from common salt is known, Mr. Weldon's name was a household word. Not himself a manufacturer, his prolific brain devised a large number of most valuable improvements in various details of almost every branch of the alkali manufacture, including bleaching-powder, etc. He knew almost every alkali works in Europe, and his labors abroad received the recognition of the grand cross of the Legion of honor. His addresses to the society were most valuable *résumés* of the position and prospects of the alkali trade at the time at which they were delivered, and such as probably no other man could have written.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Flood Rock explosion observed at Princeton, N. J.

WE had arranged to observe the arrival and character of the wave by reflection of images in mercury, and precaution was taken to stop all movement of pedestrians and vehicles within 500 or 600 feet of the observatory. At eleven o'clock (standard time), Professors Rockwood, McNeill and myself, were at our posts. Between 11.05.25 and 11.07.40 we, all three, observed, accordantly, a series of four slight tremors which blurred the reflected images in a pronounced manner. We now suppose they were due to trains on the railroad three miles away, or to carriages on the main street, distant more than 1,000 feet; but at the time we had no doubt that they were due to the explosion; and so, at 11.10, I stopped the chronograph, and took off the sheets.

Having a spare half hour in the morning, I had rigged up a very rude, but fairly delicate, vertical seismoscope, which was connected with a cylinder of the chronograph so as to make an automatic record of anything vigorous enough to affect it; but it was not sensitive enough to feel the tremors above mentioned. While I stood at the table reading off my sheet, suddenly, without any apparent cause, the seismoscope magnet began to rattle. I immediately took the time from the clock, and, all corrections applied, it gives $11^h\ 14^m\ 41^s \pm 1^s$, eastern standard time, as the beginning of the signal. Mr. McNeill instantly went to his instrument, and found the mercury strongly disturbed: the reflected image was invisible at first, but the disturbance ceased in about

20 seconds, with a series of small north and south oscillations. My daughter, who was sitting in the second story of my house, at the same time (as proved by her mantel clock) felt the floor quiver, and heard the windows rattle. As the explosion, according to the New York papers, occurred at 11.13 ± some uncertain number of seconds, and as the seismoscope registered no other shock between 11.00 and 11.20, when traffic was resumed, there can be no doubt that we caught the explosion wave, which was much more vigorous than I had expected, at a distance of fully 50 miles. I suppose we did not get the beginning of the disturbance, which probably began gently and rose to a maximum like any other earthquake.

The delay of 13 minutes at New York was very unfortunate, and caused the total or partial loss of many valuable observations. One cannot suppose that it was intentional; but it put all other observers at a great disadvantage, as compared with those of the engineer corps, who received a telegraphic signal from the firing key. The officers in charge, knowing of the elaborate preparations made for observations along other lines than the two occupied by their own men, ought to have taken great pains to prevent it.

C. A. YOUNG.

Princeton, N. J., Oct. 12.

False report of the fall of a meteorite in western Pennsylvania.

On the afternoon of Saturday, September 26, at a little after four o'clock, loud detonations were heard over a considerable area of western Pennsylvania, and circumstantial reports were subsequently given in the press of the fall of a large meteorite, which was described as being half buried in the ground and visited by numbers of people. On examination, these latter reports appeared to me to be unfounded, and I should have given the matter no further attention but for the numerous inquiries which are being addressed to this observatory with requests for specimens. To settle the question, I sent a competent observer, Mr. J. E. Keeler, to the scene of the alleged fall near the West Virginia boundary in Washington county. After an investigation on the spot, he finds that no meteorite has been found. A meteorite undoubtedly passed over, and was seen by Mr. Buckston and others to burst in a southerly direction from the town of Independence. The report, according to Mr. Buckston, was heard a minute or more after the explosion was seen, and from this and the apparent height at which he saw the meteor burst, Mr. Keeler infers that the actual explosion occurred twelve or fifteen miles to the southward, when the meteor was still two or more miles above the earth. In spite of statements to the contrary, no fragments are as yet known to be found.

S. P. LANGLEY.

Allegheny, Oct. 7.

Spectrum of the great nebula in Andromeda.

A week or two since, the finding of bright lines in the spectrum of the great nebula in Andromeda, found place in your columns. Since then by the aid of the spectrum of β Lyræ and γ Cassiopeiae certain results have been obtained.

The line described in the last notice as crossing the spectrum is H β, and is due to the brightening of the aurora as a whole.

The two lines described as appearing as bright knots have wave lengths 5312.5 and 5594.0. Thus agreeing well within the limits of error with 1250 +20 and 1474 of the solar corona, lines which are also found in the auroral spectrum, and in the spectrum of a solar protuberance (Schellen. 2.136).

In spite of the uncertainties natural to the observation and identification, the resulting suggestion of a similar origin for the light of the new star is not without considerable interest. O. T. S.

Yale college observatory, Oct. 5.

Science in common schools.

Your notes on teaching science to children need qualifying, so far as inference is concerned. The boy of nine years was evidently badly managed, but a boy of nine with a good head is capable of comprehending physiology, botany, geology, biology, if properly taught. The chief difficulty with the case in hand was that his information led to a cuteness of intellect. He would be set down for a 'smart' boy. Of all the text-books for the young the one that best suits me is Shaler's 'Geology for beginners.' This I have allowed my nine-year-old to use during the past summer. He has talked over each chapter with me, and we have discussed matters as if both were boys, using simple words, but no tricks of illustration, such as your boy seems to have been indulged with. Occasionally he has been exercised in an attempt to tell the contents of a few pages where these together make one picture. In no case has he verbally memorized, except to clearly comprehend the division of protozoa, mollusks, articulates, vertebrates, and that of orders, species, etc. Having once finished a chapter, we reviewed it to call out new points and illustrations. This book has been his story book; he will not read an ordinary story when such material is at hand. To say he fully comprehends the theories advocated by Professor Shaler is not to say too much. As he is four-fifths of his time out of doors or working with his tools, it has been easy to make the soil and the stones under foot illustrate his book. Now, if any one will write as good a biology, the nine-year-old shall have that next; then botany and physiology. I am suspicious of pen-work at this early age. It is a precocious, unnatural cramping of a boy's knowledge into formal artistic shape. It involves the art of expression and the art of restraint, or a skill in leaving out as well as putting in. The boy would best be left to talk the subject over in free language.

But when shall pen-work begin? Later; at about about twelve years or fourteen. Then let the lad have a portfolio and write something on any topic he is thinking about each day of his life. Nothing spoils a mind so quickly as composing, as nothing so assists if wisely managed. I should decidedly prefer that the first efforts of composition should be in the dramatic form. Let him set his characters talking, and put in their mouths the notions he has of them. For instance, Garibaldi, King Victor, Cavour, Louis Napoleon, or President Cleveland and his cabinet talking over the Indian question. Contemporaneous history being his regular historical study, his characters should be living characters, or mainly so.

The composition on iron ores is, however, a most excellent specimen of descriptive writing for a very

young pupil. It is, I take it, by a girl, though your article says a boy. But is there much real value in the exercise even when such clearness is attained?

I make it a conscientious matter from the first to answer all child questions about nature in a truthful manner. They are never put off with false theories involving supernatural or other agencies. For instance, what child fails by three to five years of age to ask how do the stars stay up there? How easy to put him off with some farcical or miraculous supposition. On the contrary, the simplest possible attempt should be made to give him the real explanation. Will he understand it? If not entirely, he will be on the right road. There will not be something to undo by and by. Why can he not understand attraction as well as you or I? Only he must have it explained by what he is familiar with.

We are getting on the right track. Science furnishes studies infused with romance. No novel has the fascination for young people of a well-told geology or biology. E. P. Powell.

The care of pamphlets.

Every scientific library, public or private, contains pamphlets by the thousand, and nothing is more necessary for the accommodation of those who use it than some available system of binding which shall preserve from destruction and at the same time be accessory to a convenient system of classification.

Some system of permanent individual bindings is needed which shall afford 1°. permanent protection; 2°. the possibility of a perfect classification, and the intercalation of new material from day to day; 3°. opportunity for perfect labelling and cataloguing; 4°. the greatest convenience to the reader. The best endowed public libraries can perhaps afford to pay a bookbinder to put separate covers on pamphlets, and it is the practice of many of them thus to care for the most important. The cost is, however, very considerable. What the private individual needs is a binding-case much more inexpensive—one in which he can himself insert his pamphlets. Feeling sure that it was possible to meet this need, I undertook an investigation. The bookbinders, with their skilled workmen and their expensive binder's board, did not seem to be in a position to supply this demand. I found upon inquiry that the simplest form of binding-case cost from twelve to fifteen cents. I next turned to the paper-box manufacturers, who employ unskilled laborers, and who use less expensive materials. I found that binders for octavo pamphlets, when ordered in considerable quantities, could be made for $4.50 a hundred, and quarto binders for $7.50 a hundred. These binders are made with sides of thick paper-pulp board, which is not likely to warp, and with backs of binder's muslin, and are covered with binder's paper. They have muslin stubs, upon which the pamphlets may be glued, and may be made of varying thickness. The most useful sizes will doubtless be one-eighth, one-quarter, one-half, three-quarters and one inch. The sizes I use are, octavo, 6 3-4x10 inches; quarto, 10x12 inches. The octavo covers are made larger than the ordinary octavo page, to include papers in imperial octavo; duodecimo pamphlets may also be put in these covers, for the sake of uniformity, and convenience in classification. Each binder has a blank label on one of its upper corners, upon which the name of its contents are written. I arrange these in paper boxes, upon ordinary book shelves, so placed that the contents of each box may be handled in the same manner as the cards in a card catalogue, the position of the title labels facilitating this operation. A system of deep drawers would be equally convenient.

I also use these pamphlet-cases for filing letters, photographs, newspaper clippings and other literary material. A stout manilla envelope being glued to the stub with its opening to the right, and next to the back, is covered and protected by the sides of the binder, and may be filled with loose papers, their character being indicated upon the label outside. The binder may then be arranged with the pamphlets or elsewhere. Classified scrap-books may very easily be made by fastening a few sheets of book paper to the stubs, and bundles of letters may be bound in in a similar manner. I have for years used binding-covers of a still cheaper and simpler form, which are simply sheets, 9 1-2x13, made of the stout, thick paper used in herbaria for genus covers. These are fastened to the pamphlets by the use of the patent staple-like paper fasteners, sold by stationers. They are labelled and arranged in the same manner as the binders, as described above, and serve an excellent purpose, the paper, though less indestructible than is desirable, being very stiff and durable. It is simply waste of time to use even the thickest of ordinary manilla paper for this purpose.

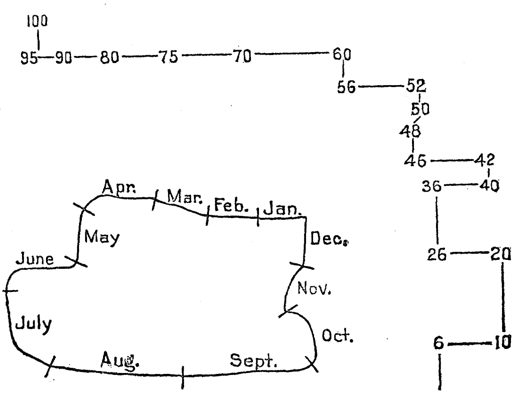
This note is sent in the hope that it may draw forth descriptions of other methods of caring for pamphlets. G. Brown Goode.

U. S. national museum, Washington.

Color and other associations.

In *Science* for the 18th of September, I was much interested in the letters on 'color and other associations,' for I have always experienced similar illusions. According to my fancy, the months have always appeared as below.

The days of the week are in the form of a circle, Sunday on top, Thursday below; the days rotating from right to left. Sunday appears yellow, Monday pale straw, Tuesday green, Wednesday yellow, Thursday orange, Friday black, and Saturday whitish gray. The numbers arrange themselves as follows:



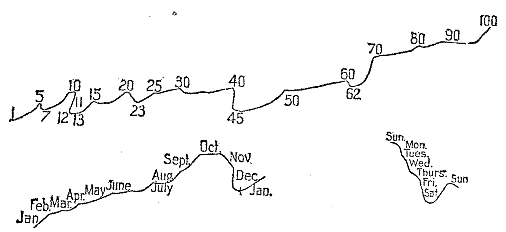
When I think of a number I always place it in the diagram. Above 100, the numbers go between the hundreds like the diagram, and the hundreds themselves follow a similar course.

In committing prose or verse to memory, the positions of the paragraphs fix themselves in my mind so firmly that when I recite I almost read the words from the air before me. unless I have learned them by ear, in which case there is no illusion at all.

THATCHER T. P. LUQUER.

Bedford, N. Y., Sept. 28.

The matter of forms in series of numbers, months and days seems of considerable philosophical interest. Is there not herein a hint that, although to broad features, the great principles of mental states and operations are everywhere the same, yet the minutiæ may be utterly incongruous and irreconcilable ; and hence, that in the minute analysis of these things philosophers must always in a measure fail, because the assumption on which all philosophy is built, that minds act alike, proves to be not wholly reliable ? What seems a necessity of thought, or at least a constant accompaniment of thought to one, seems ridiculous and unthinkable to another. Such forms have existed in my own mind from my earliest remembrance, yet I never thought of them as other than naturally common to all, till within a few years,



finding them entirely wanting to some minds. The annexed diagrams show that, while the numbers and the months take in general an ascending direction, the days of the week have a steep grade downwards to my mind.

SILVANUS HAYWARD.

Southbridge, Mass.

Some notes on color in *Science* recently recalled a study made by me when in Chicago a few years since. I was made president of the Kindergarten association when it was formed in 1875. This gave me occasion for several very curious lines of inquiry. Only one of these will be appropriately recalled now. A casual remark of that able teacher, Mrs. Putnam, led me to ask her which gift the children under seven first chose. She answered yellow. I said, "What, in preference to red or blue!" "Yes," she repeated. "with only one exception, invariably yellow." I then inquired of Miss Eddy, whose fine powers of observation were unequalled, and her answer was yellow. I could hardly believe it ; but from every teacher there; or elsewhere, I have received the same answer, a few adding that they have had in charge a few children who were exceptions. This tallies with my recollections of my own childhood, and is confirmed by others. If it be an established fact, which I will not aver, to what shall we attribute it ? Is it improbable that there is an unconscious relation between the growing child and the ray most concerned in growth, as there seems to be between old age and the red ray ? We certainly outgrow at an early age our preference for the yellow.

E. P. POWELL.

Clinton, N. Y.

Ball of electric fire.

MR. J. V. WURDEMAN says that a ball of fire, as large as a child's head, came into his room at Leavenworth, hopped across the floor like a soap bubble rolling on a carpeted floor, went out through the side of the house at the corner opposite to where first seen, with a sort of explosion, or rather puff, not nearly so loud as a pistol shot nor so sharp, and tore off the rain pipe of tin. It looked like an electric brush, not brilliant nor like the electric spark. His son, a little child, was playing on the bed : his mother snatched up the boy and was half way down stairs before the ball disappeared. The ball seems to have been like the St. Elmo lights. which I have seen on a vessel's yard arm. in the Gulf of Mexico, a pale brush of light, spherical in form, like the brush issuing from a metallic point in the prime conductor of the frictional electric machine.

M. C. MEIGS.

Voss-Holtz electrical machine.

A few days ago I accidentally received a pamphlet on the theory of the Voss-Holtz electrical machine, by E. B. Benjamin, dealer in physical apparatus, New York City.

The article states that "no perfectly satisfactory explanation of all the phenomena manifested by this machine has yet been made public in this country," and then gives the theory that was published in *Science*, for June 20, 1884. In many places the sentences are the same, almost word for word, except that he has lettered the parts of the machine, and used the letters for the names of the parts.

Mr. Benjamin gives no credit either to *Science* or to the author, and further copyrights, by itself, the part of the pamphlet containing the theory, the date of the copyright being 1885.

H. W. EATON.

Louisville, Ky., Oct. 2.

Carnivorous habits of the striped squirrel.

As the carnivorous habits of the musk-rat and other rodents have been under discussion during the past year, I wish to record a rather remarkable instance, which came to my notice in New Hampshire, May 27, 1883, in case of the striped or ground squirrel, Tamias striatus (L) Baird.

The chipmunk is usually regarded as a harmless vegetarian, living chiefly, if not wholly, upon nuts, fruits, and the seeds of grain and various plants ; but this is probably not the whole truth of the matter, at least in the following case, for an account of which I am indebted to the Rev. F. M. Gray, of Plymouth, N. H.

On the morning of the day in question, he was in the woods, and stopped to listen to some bird, when his attention was called to a white-footed or deer mouse (Hesperomys leucopus, (Raf.) LeC.), which ran hurriedly past, carrying something in its mouth.

Suddenly a chipmunk, which had watched proceedings from a stump near at hand, pounced down upon the mouse, caught up what she had carried in her mouth, but had dropped through fright, and returning to his stump began to devour it greedily.

The captured prey could now be seen to be a young mouse, which the squirrel ate as he would a nut or a piece of apple, in this case beginning with the head.

To further verify the fact, he frightened the chipmunk, and brought home the half eaten young mouse, which I examined, and found to be of the species above mentioned.

Writers on our natural history have much to condemn in the carnivorous propensities of the red squirrel (Sciurus Hudsonius Pallas), of the flying squirrel (Sciuropterus volucella, (Pall) Geoff), the rats and shrews, but the chipmunk escapes without vituperation.

Speaking of the food of the striped squirrel, Audubon says, in 'Quadrupeds of North America,' "it prefers wheat to rye, seems fond of buckwheat, but gives preference to nuts, cherry-stones, the seeds of the red gum or pepperidge (Nyssa multiflora), and those of several annual plants and grasses." He mentions the case, reported to him by a Boston lady, of a ground squirrel which was seen taking young robins from the nest. This, he thinks, was an "unnatural propensity in the individual," and did not indicate "the genuine habit of the species."

Dr. C. Hart Merriam, in his 'Vertebrates of the Adirondack region,' says "the striped squirrel feeds upon a variety of nuts and roots, and is fond of corn and several kinds of grain." It is especially fond of beech nuts, and stores up the seeds of various plants, as of the buttercup; eats the tubers of the ground nut (Aralia trifolia), and the yellow 'kernels' of squirrel-corn (Dicentra Canadensis). He quotes from a writer in the *American naturalist*, who saw a chipmunk "busy nibbling at a snake that had been recently killed. He could hardly be driven away, and soon returned to his feast when his tormenters had withdrawn a short distance."

It is commonly known that the red squirrel is carnivorous to the extent of eating coccoons of insects in the spring, devouring bird-eggs, and even taking the young birds from the nest; and it is quite possible that the chipmunk, which is rarely seen in trees, may become emboldened to treat the smaller ground-building birds in a similar fashion. The wholesale destruction of birds, which is often rightly attributed to the red squirrel, may be shared in to some extent, at least, by the no less active Tamias.

F. H. HERRICK.

Recent Proceedings of Societies.

Academy of natural sciences, Philadelphia

Oct. 6.—Mr. Charles Morris made a communication on the subject of attack and defence, as determining agents in animal evolution. In considering the developmentof the dermal skeleton of animals, with its various modifications, we are led almost to the conception that nature has been controlled at successive periods by special ideas, each dominant during a long period and then abandoned in favor of a new one. We are quite sure that the first appearance of fossils in the rocks does not indicate the first appearance of life upon the earth. Early fossilization is due to the preservation of the dermal skeletons of animals of considerably advanced organization, and these were very probably preceded, during a long era, by soft-bodied forms of low organization, which could leave no trace of their existence, except in the case of the burrowing worms. The development of an external skeleton seems to have come like a new idea to nature, and was adopted simultaneously, as it seems, though probably at considerable intervals by the various types of life. At a later era, the prevailing tendency is not to assume armor but to throw it off. The labyrinthodont amphibians were clothed in armor, their heads in particular being protected by hard, bony plates. Modern amphibians are naked-skinned animals. The reptiles are usually scaled, but with the exception of the crocodiles and turtles and some few fossil types, they do not seem to have been clothed in bony armor, while in the birds and mammals all defensive armor is lost. The same tendency to pass from the armored to the unarmored state is seen in invertebrate life. These changes were held to have taken place in consequence of the reciprocal influence of attack and defence. If a food animal gained some structural feature which gave it an advantage over its carnivorous foes, the latter would be at a disadvantage until they had gained equivalent features. So, if a carnivorous animal gained some habit, motion, or weapon, which gave it an advantage in destroying, this must have acted as an incitement to a corresponding development in food animals. Illustrative facts were freely given to support the belief that four successive ideas emerge into prominence in the development of the animal kingdom. In the primeval epoch it is probable that only soft-bodied animals existed, and the weapons of assault were the tentacle, the thread cell, the sucking disk, and the like unindurated weapons. At a later period, armor became generally adopted for defence, and the tooth became the most efficient weapon of attack. Still later, armor was discarded, and flight or concealment became the main methods of escape, and swift pursuit the principle of attack, while claws were added to teeth as assailing weapons. Finally, mentality came into play, intelligence became the most efficient agent both in attack and defence, and a special development of the mind began. As a culmination of the whole, we have man, in whom mentality has replaced all other agents in the struggle for existence. But side by side with man all the other types exist, the soft-bodied, the armored, the swift moving, and those in which cunning precedes the higher mentality. In the existing conditions of life on the earth, we have an epitome of the whole long course of evolution. Prof. Heilprin, while agreeing in the main with Mr. Morris's arguments and deductions, remarked the occurrence of certain conditions among early organic forms, which, from the position defined, would be anomalous. The Cambrian trilobites, the largest organisms apparently of their time, were already clad in very perfect armor. Was this the result of evolution without the necessity for defence? The most highly armored ganoid fishes are those of the shortest period of existence. The huge carboniferous amphibians are cased in armor, without the existence of contemporaries at all powerful enough to inflict damage on them; while at the present time the unprotected ant eater lives side by side with such armored forms as the armadillo.——Mr. Redfield called attention to the fact that in the vicinity of Mt. Desert the traces of glacial action were very obscure, and stated that this had been accounted for by the theory that the region had been submerged for a sufficient length of time to remove the striæ from the softer rock. On the hard quartz veins the scoring was evident, while farther inland the slates and softer deposits bore clear traces of glacial scratching. The subject was further considered by Mr. Aubrey H. Smith and Prof. Heilprin, the latter holding that the geologists were apt to

push the theory of submergence too far in accounting for such phenomena.

Calendar of Societies.

Boston society of natural history.

Oct. 7.—Dr. S. Kneeland, The family-life of the Norwegian Lapps, and the habits of the reindeer.

Society of Arts, Boston.

Oct. 8.—Prof. W. T. Sedgwick, The relative poisonous properties of (illuminating) coal and water-gas.

Cambridge entomological club.

Oct. 9.—George Dimmock, An account of his mode of rearing larvae of Coccinellidae.

American academy of arts and sciences, Boston.

Oct. 9.—Mr. Seth C. Chandler, Jr., On the square bar micrometer.—Prof. Arthur Searle, On the apparent position of the zodiacal light.—Messrs. Chas. R. Cross and James Page, The measurement of the strength of telephone currents.—Prof. Charles R. Cross, The thermal telephone.

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SCIENCE.—SUPPLEMENT.

FRIDAY, OCTOBER 16, 1885.

EDUCATION AND THE HEALTH OF WOMEN.

THE tendency to apply the exact methods of science to problems of education, is one of the most hopeful signs of present pedagogy. One of the more fruitful lines of application will be found, doubtless, in the consideration of educational questions in relation to the wider sphere of social science, and the application of the statistical method. As one of the first fruits of this application, we hail the returns collected by the Association of college alumnae, wisely embodied in the current report of the Massachusetts labor bureau. These are directed especially to ascertaining the effect of education upon the health of women, but there are incidentally discussed a number of other very interesting problems. The returns include 12 institutions, which had (1882) graduated 1,290 women, from 705 or 54.65 per cent of whom returns have been received. Of these the average age at beginning study was 5.6 years; at beginning of menstrual period, 13.6 years; at entering college, 18.3 years; and at the present time, 28.5 years. This gives about six years as the average time since graduation, certainly ample for the determination of the general effects upon health of their collegiate training. Of the 705, 19.5 per cent report a deterioration in health during college life ; 59.3 per cent, no change ; 21.1 per cent, an improvement. The corresponding figures for working girls of Boston show a deterioration of 16 per cent, a favorable balance of 3.5 per cent in favor of the working girls. The total number of disorders reported by the 705 is 865. The aetiology of disease, as reported, is exceedingly defective, but we give it for what it is worth. 135 consider constitutional weakness cause of disorders; 81 bad sanitary conditions; 81 intellectual overwork; 73 emotional strain, and 47 physical accident, while the others report no cause. Defective as this report is in detail, it is remarkably suggestive. The general conclusion stated in the report is that the health of women engaged in the pursuit of a college education, does not suffer more than that of a corresponding number of other women in other occupations, or without occupation.

This general conclusion may be allowed to stand. But the figures are not 'worked for all they are worth.' A more detailed examination of them brings out the following points which the report fails to explicitly notice.

Of those who entered college one or two years after the commencement of the menstrual function 20.5 per cent had poor health during the four years of college life, while of those entering three to five years after its establishment 17.7 per cent, and more than five years 15.4 per cent had poor health. The following figures tell the same story with slight variation : of those who entered at the age of sixteen, or under, 28.1 per cent deteriorated, 17.2 per cent improved in health; of those seventeen to nineteen 17.3 per cent deteriorated and 19.7 per cent improved ; while of those who were twenty or over 17.9 per cent deteriorated, while 28.4 per cent improved—almost exactly reversing the figures for the youngest class. The fact that of the married 37 per cent are without children, although the average number of years spent in married life is 6.2, must be included in any discussion that wishes to reach complete results. There were, moreover, to those bearing children but an average of two children to every seven years of married life, while, if all married couples are included, the average falls to 1.2 children for five yerrs. With such statistics, however, there must be borne in mind the general falling off in fertility of all women occupying about the same social rank. Of the children born, 12 per cent have died, and of these the unusually large per cent of 25 is due to causes occurring contemporary with birth, still, premature birth, etc.

The following figures fall into the same category. During the period of development 53 per cent were troubled during the menstrual period with disorders, including irregularities, uterine and reflex pain, one, two, or all three. During college life the per cent was 66; since graduation 64. If mere irregularities be isolated, and they and the more organic disturbances treated separately we find: Irregularities alone—development, 16 per cent; college life, 9 per cent ; graduate life, 7 per cent. Uterine and reflex pain—development 24 per cent; college life, 36 per cent ; graduate life, 36 per cent. Of the disorders reported 7 per cent are brain troubles, 33 per cent nervousness, in addition to which 15 per cent report neuralgia; 26 per cent disorders of generative organs.

We give only figures, and these only such as bear directly upon the central question of the health of woman in reference to her education.

They certainly show that the time for optimistic congratulations is not yet reached.

The other general conclusion of the report that such falling off in health during college life, as did appear, is due rather to predisposing causes, than directly attributable to college life itself, brings out some very interesting contributions to the scanty generalizations we already possess, concerning the relations between health and social environment. First as to heredity: A total of 35 per cent report a tendency to disease inherited from one or both parents. Those inheriting tendency from one parent only present some slight falling off in good health when compared with the entire average; while for those inheriting from both 58.3 per cent are in good health; 41.7 in poor, the average for all being 83 and 17 per cent respectively. For the 65 per cent inheriting tendencies from neither the figures are 85 and 15. As to relative change there is for those inheriting from both a relative decrease of 19.5 per cent in those having excellent health; an increase of 24.6 per cent in those having poor; the corresponding figures for those inheriting from neither being an increase in good health of 2.6 per cent, a decrease of poor of 1.6. The following tables show the effects of exercise, worry and study upon health:

EXERCISE.

Hours taken.	Health.	
	Good.	Poor.
	Per cent.	Per cent.
0–2	75	25
2–6	83	17
6 and over	84	16

WORRY.

Concerning.	Health.	
	Good.	Poor.
	Per cent.	Per cent.
Study	80	20
Personal affairs	75	25
Both	68	32
Neither	92	8

The differences in the last two results furnish one of the most interesting contributions yet made to the student of sound sanitary, social, and moral conditions.

STUDY.

Amount.	Health.	
	Good.	Poor.
	Per cent.	Per cent.
Moderate	85	15
Moderate to severe	83	17
Severe	79	21

The report upon the whole is surprisingly full. For the social student, however, it presents certain notable deficiencies. The physical, social and moral environment of the students during college requires infinitely more investigation. The details concerning intellectual surroundings are comparatively full, though the number of hours of study should be given instead of the indefinite terms, 'moderate,' 'severe.' The inquiries concerning social surroundings are virtually confined to the inquiry as to whether the person 'entered society,' a little, a good deal, or none. Such vague expressions are worse than none. The question is as to how the student spent the hours of social recreation, and how many were so spent. The complete answer of this question, it is hardly too much to say, would throw more light on the hygienic problem than almost all else. It should include information as to whether the institution is female only or co-educational; what its social relations are to the town in which it is situated, the nature of the town; whether the young women live in dormitories, in cottages, in selected homes, or in ordinary boarding-houses; what regulations, if any, the faculty have made concerning study hours, and the hours not spent in study; whether the institution has a matron; whether her duties extend to moral and social matters, or to physical only; whether the institution has a gymnasium, etc. Complete answers to such a protocol of questions as these suggest would show what was meant by saying that 81 regard bad sanitary conditions as cause of their diseases, 135, constitutional weakness, and 73, emotional strain. If the association will study the conditons of the problem along this line, and frame questions accordingly, they will deserve still more at the hands of both the scientific educator, and the social student. Meanwhile we will be thankful for what we have.

JOHN DEWEY.

THE CLAPP-GRIFFITHS BESSEMER PLANT.

THE Bessemer process of converting molten cast-iron into steel by oxidizing and removing its carbon and silicon by blowing immense volumes of air through it, appears to be entering a new phase. Aiming for many years almost solely at the production of rails, the captains of the Bessemer industry found it much easier to satisfy the demands of purchasers as to the quality of their product than those of their employers as to its quantity. Hence arose the present type of Bessemer plant, in which no expense of construction is spared which promises to increase the quantity and thus to diminish the cost of the product. To-day, however, the uses of Bessemer steel are being rapidly extended and diversified. While most of the new demands

can be most naturally and economically supplied by the large Bessemer works in our manufacturing centres, the magnitude of whose operations enables them to profitably employ the best talent and machinery and to produce at the smallest cost, geographical conditions occasionally favor the erection of small steel works; for example, where a special demand for Bessemer steel, too limited to warrant the erection of full sized works arises in a place remote from all existing Bessemer works, and where pig-iron is cheap, owing to the immediate vicinity of iron blast-furnaces. Here it might be cheaper to convert the local pig-iron into steel at local works, even if they be so small that the cost of treatment is somewhat high, than to transport the iron to distant works, have it there converted into steel, and then bring it back to the starting point.

To meet such cases several small and comparatively cheap arrangements of the Bessemer plant have been designed, and one of these, the Clapp-Griffiths, has kindled quite a glow of interest in this country, which judicious and energetic fanning and puffing bid fair to convert into a veritable craze. Since the arrangement aims at a comparatively small output, some sacrifice of rapidity and cheapness of working are properly made in order to diminish the cost of the plant itself. The costly rotating converters of the ordinary plant are replaced by the cheap Swedish stationary converter. The blast is introduced, not as in the ordinary converter at the bottom of the deep bath of metal, but near its upper surface, so that, having little resistance to overcome, blast at low pressure, and hence furnished by cheap blowing apparatus, may suffice. Moreover, towards the end of the operation and while the steel is being tapped out of the converter, the blast is admitted very slowly, to avoid 'over-blowing'; and a hole is provided in the shell of the converter at such a height that the slag runs out through it during the converting operation. I mention these latter details because they are supposed to play an important and unlooked-for part in the chemistry of the process; indeed, the plant itself, of good but not remarkable design, is of interest to the readers of *Science*, chiefly because it is claimed that it removes silicon more uniformly and completely than the ordinary Bessemer plant does. The effect of phosphorus in rendering steel brittle has long been known to increase with the proportion of carbon present. A percentage of phosphorus which would have little effect on steel containing only 0.15% carbon would change steel with 0.5% carbon from a valuable ductile metal to a worthless brittle one. While some have maintained that silicon *counteracts* the effects of phosphorus, many have long believed that like carbon it greatly *exaggerates* them. This belief is somewhat strengthened by the fact that phosphoric samples of Clapp-Griffiths steel, when low in both carbon and silicon, are surprisingly ductile. But whether their ductility be due merely to low carbon or to the combination of low carbon with uniformly low silicon, it is interesting to inquire whether it be due to conditions which can be regularly imitated in the large scale Bessemer works; if it be, then, since the magnitude of their operations enables them to produce more cheaply, an important if not the chief ulterior result of the development of the Clapp-Griffiths plant and practice will probably be to teach the metallurgists of our large works how to produce more uniformly ductile steel from given pig-iron, and, aiming at a given degree of ductility, to employ more phosphoric, and hence cheaper, pig-iron than heretofore. Let us, therefore, consider the explanations which have been advanced of the results obtained in the Clapp-Griffiths practice.

1. The uniformly thorough desilicidation has been attributed to the unusually low blast pressure employed. While it is conceivable that, by increasing the tendency of carbon and oxygen to dissociate this might favor the oxidation of silicon, this explanation seems far fetched and insufficient. But, if low blast pressure be the cause, the ordinary Bessemer works can employ it by making their vessels wider and the bath of metal shallower than at present.

2. It has been attributed to admitting the blast near the top instead of at the bottom of the bath of metal; this is supposed to cause a local excess of oxygen in the upper part of the bath with the formation of iron-oxide (the copious evolution of red smoke at the commencement of the operation is adduced as evidence of this) which is supposed to attack silicon rather than carbon. But the early appearance of iron-oxide in the flame of the Clapp-Griffiths converter may indicate, not that it is a more active, but actually a less active agent than in the ordinary converter (I will not pretend to say what its true significance is). If we confine our ideas to a very minute quantity of metal immediately in front of any one tuyere of the ordinary converter we realize that, in this restricted space, oxygen is nearly, or perhaps quite, as much in excess as it is in a similar space in front of a Clapp-Griffiths tuyere. If iron-oxide forms in the latter, it will also, and perhaps to an equal extent, in the former. We do not see it escaping from the ordinary converter, probably because it is reduced by the carbon and silicon and slagged by the silica it encounters in its long upward path through the superincumbent metal, while in the Clapp-Griffiths converter, dragged along by the blast, its

travel to the upper surface of the metal is so short that it does not have opportunity for complete reduction and slagging. Now iron-oxide can only remove silicon by being reduced by it, or by combining with already formed silica and thus preventing its reduction. Its appearance in the flame of the Clapp-Griffiths converter at a period when it is absent from that of the ordinary converter may indicate, not that it is formed more copiously, but that it is reduced and slagged less completely in the former than in the latter.

3. It has been attributed to the partial removal of the slag (whose silica might have been reduced had it remained as it does in the ordinary converter) during the converting operation. But the slag can be removed from the ordinary large rotating converters as well, and without serious expense or trouble, by turning them down 90° and skimming it at any desired stage of the process.

4. Finally, there are scoffers who say, "We believe that the removal of silicon bears the same relation to that of carbon in your converter as in the ordinary converter. Your analyses, apparently intended to show that your converter specially favors the removal of silicon, do not even point in that direction. The ductility of your phosphoric steels is indeed due to their being uniformly low in carbon and silicon. But this in turn is due to your admitting the blast so slowly towards the end of your operation that you can hit the point of complete removal of carbon and silicon more accurately than we can in our large converters with our present practice of blowing rapidly to the very end. But many feasible plans at once suggest themselves by which we may accomplish this in the ordinary converters. Creditable statements that at least one large scale Bessemer works is actually producing steel as uniformly low in carbon and silicon as yours, strengthen this belief."

It is too early to decide positively which, if any, of these explanations is the true one. If any of them be, it is highly probable that the excellent metallurgical results of the Clapp-Griffiths practice will be successfully imitated by the large Bessemer works.

The validity of the claim that the Clapp-Griffiths steel is superior to that of identical composition made in the ordinary converter can only be admitted on the production of far more conclusive evidence than has yet been offered.

Henry M. Howe.

ACTIVITY OF THE MIND DURING SLEEP.

In connection with the present activity in psychical research, the following extract from the recently published 'Life of Agassiz' (Boston, *Houghton, Mifflin & Co.*) is of interest:—

"He [Agassiz] had been for two weeks striving to decipher the somewhat obscure impression of a fossil fish on the stone slab in which it was preserved. Weary and perplexed he put his work aside at last, and tried to dismiss it from his mind. Shortly after, he waked one night persuaded that while asleep he had seen his fish with all the missing features perfectly restored. But when he tried to hold and make fast the image, it escaped him. Nevertheless, he went early to the Jardin des plantes, thinking that on looking anew at the impression he should see something which would put him on the track of his vision. In vain,—the blurred record was as blank as ever. The next night he saw the fish again, but with no more satisfactory result. When he awoke it disappeared from his memory as before. Hoping that the same experience might be repeated on the third night, he placed a pencil and paper beside his bed before going to sleep. Accordingly, toward morning, the fish reappeared in his dream, confusedly at first, but, at last, with such distinctness that he had no longer any doubt as to its zoölogical characters. Still half dreaming, in perfect darkness, he traced these characters on the sheet of paper at the bedside. In the morning he was surprised to see in his nocturnal sketch features which he thought it impossible the fossil itself should reveal. He hastened to the Jardin des plantes, and, with his drawing as a guide, succeeded in chiselling away the surface of the stone under which portions of the fish proved to be hidden. When wholly exposed, it corresponded with his dream and his drawing, and he succeeded in classifying it with ease. He often spoke of this as a good illustration of the well-known fact, that when the body is at rest the tired brain will do the work it refused before." (p. 181.)

DEATHS FROM WILD BEASTS AND SNAKES IN INDIA.

From time to time the Indian government issues reports on the yearly loss of life by snake-bite and wild beasts,—reports which still show a frightful mortality from these causes, and afford significant evidence that the present precautions and exertions of the government in this direction still fall wide of their object. The latest intelligence in the *Gazette* states that in 1883 about 22,000 men died from the above mentioned causes. The returns from the district authorities can by no means be considered complete and satisfactory, since in consequence of the apathy of the natives and the almost universal belief among them in kismet, or predestination, many cases are not reported at all

Translated from *Das ausland.*

and escape the knowledge of the authorities. It must be remembered also that the records of the government include only the cases occurring in British India, while there is no record whatever of the mortality from these causes in the independent states like Jeypoor, Gwalior, Rewah and many others, which are governed by independent rajahs or princes. The British system of dealing with wild beasts and harmful reptiles has not yet been introduced into these large districts; and the natives do not encourage by premiums and rewards the extermination of tigers, panthers, and various cat-like animals, as they do that of cobras and other poisonous snakes; whereas in British India their destruction has become a trade and means of support. Accordingly it happens that in the more distant parts of India which are not yet under British rule, the mortality from these causes is about as great as it was before the British supremacy over India.

Among the animals so destructive of human life, the tiger naturally stands first, and the report of 1883 lays to his charge not less than 985 deaths; and yet this animal, if it remains undisturbed and is not irritated, seldom attacks men. Tigers as a rule are cowardly, and are only too glad to steal away at the approach of man. In earlier times, and this is especially true of British India, when tigers were more numerous than they are at present, so-called man-eaters were by no means rare among them. They were so named because after once tasting human flesh they were said never after to eat other meat. At that time it was not unusual to hear of unused highways, of large stretches of land left uncultivated, and of abandoned villages falling into ruins, because the ravages of this fearful animal drove away the inhabitants. To-day these man-eaters are almost exterminated; if one is heard of, the attention of the authorities is soon drawn to his actions, a hunt is organized, and usually the animal is soon killed by the rifle of a European sportsman or the gun of some private hunter.

The question naturally arises, if the man-eaters are so rare, how does it happen that in a single year almost a thousand men lose their life from tigers? In the first place it cannot be doubted, although tigers eating only men are now fortunately rare, that a tiger if he is surprised in his lair, or comes face to face with a man in his wanderings, under the impulse of the moment and perhaps more from fear than any other reason, knocks the man down and then goes off. Cases of this kind frequently occur in wooded regions. A tigress with young is especially dangerous, and often attacks unprovoked any one approaching the place where her young are.

Again, herdsmen, or gwallas, as they are called in Bengalee, frequently lose their lives, if, in their exertions to rescue one of their herd from the claws of the destroyer, they too greatly expose themselves. In such cases the tiger is very dangerous; he has perhaps aleady tasted blood, and will usually give up his booty only after a struggle. If several men, arranged in a compact form, press upon him, as, ready to spring, he cowers on the ground behind the bull slain by him, he will often slowly and unwillingly retreat, but often, too, made furious by the sticks and stones thrown at him, and by the cries of his bold antagonists, he will break forth to the attack with enraged cry and blazing eye, and knock down one or more of them.

The chief cause of death by snake-bite is the almost universal custom among the poorer classes of natives of travelling in the hot season by night, without torches or lanterns. The European in India never does this; if he wanders by night about his bungalow or house, or in his garden, he carries a lantern, on his nightly journeys a burning torch, which snakes are known to avoid. To be sure, cobras are night animals; by day one seldom meets them. but after sunset they come out of their hiding places to seek food. A native usually goes barefooted, or wears a low shoe which protects neither ankle nor leg. In the dark he steps on or pushes against a poisonous snake, is bitten, or rather struck at, and probably by daybreak lies dead at the side of the road.

The same careless custom of wandering after sunset through jungles which are inhabited by wild beasts of all kinds, is, although in less degree, a constant source of danger only too frequently involving death. As already remarked, a tiger, if he is left undisturbed, seldom attacks man in the daytime, but much oftener, if unprovoked, creeps away with an angry growl. This rule does not apply to encounters by night. All rapacious animals go at that time for prey, and appear to be fully conscious of their advantage over man in their sharper vision adapted to the thick darkness of night. Consequently there is for the traveller not only the greater probability of meeting dangerous beasts of prey if he traverses the forests by night, but the tiger and the other rapacious animals of the forest are then bolder and more to be feared; and although the tiger is by nature cowardly, yet under the protection of the darkness and the impulse of hunger, the sound of human voices in the stillness of the night may attract him nearer to the road, and a crowd of unarmed natives, passing only a few arms lengths from his lurking place, may arouse still further his wicked instinct. If the temptation prove too great, with

a single spring he alights upon one of the unfortunate travellers, and bears off his shrieking victim.

We learn from the *Gazette* that in 1883 not less than 47,487 cattle were destroyed by wild beasts, and it cannot be doubted that in this connection the tiger is especially destructive, and from this cause there is a very heavy tax on the natives dwelling in villages near large forests. A couple of royal tigers will probably within a month kill and consume ten or twelve grown oxen or cows, and a tigress with two or three almost grown young is perhaps even more destructive, for she takes pleasure not only in killing for the nourishment of her young, but will often kill several at a time out of pure malice.

There are tigers which live almost entirely upon large animals like deer and boars, and only rarely approach villages and human settlements; rather the majority of them depend for support upon domestic cattle, and that is not to be wondered at. The ruminating animals of the forest are shy, restless creatures, ever on the watch for danger, and so careful that a tiger, in spite of his cunning and noiseless approach, never succeeds in springing upon such animals and in successfully tearing them down. The tiger is more fortunate if he lies down in the neighborhood of a spring in the jungle, and there hidden, awaits the deer coming after a long hot day, half dead with thirst, impatient of the approach of night, and careless, in order to obtain the long-desired water.

But a tiger soon discovers that he can obtain his food with much less trouble and exertion, if he attacks herds. This is not only easier, if the herd pastures at the edge of a jungle,—quite unlike deer, which are always cautious, and in a trice in flight if they scent the enemy,—but a herd of cattle moved by fear will stand as if bound, with their whole attention directed to the striped robber, when crouching to the ground he quickly approaches to springing distance. Then, when flight is too late, the foolish animals try to escape, but with a single spring the tiger is among them, seizes his victim with his powerful grasp, tears it down, and kills it with one bite of his strong jaws.

The Asiatic lion, which is still found in a few provinces, in Cutch, Guzerat, and a few parts of Bombay, but is rather rare, was formerly considered by naturalists on account of a single characteristic peculiarity (namely, the almost entire lack of a mane in the males and his smaller size), as a species different from the African lion; but they are now considered identical. Little is known of the manner of life and the habits of the Asiatic lion. Hunters describe him as a dangerous animal when pursued; but if not provoked or attacked, he appears, like the tiger, to avoid as far as possible, encounter with man; and apparently at nightfall he is not so bold and dangerous as the African lion. On the other hand, a lion, creeping along on the ground in the grass or in the undergrowth, even in comparitively open country, is much more difficult to distinguish than a tiger, because his brown spots resemble the color of the surroundings. It should be stated that it is a mistake to suppose that the lion in his natural state has the long flowing mane which we see in the caged specimens. Lions often live in close thorny thickets, and their manes, through the constant combing on the thorns, and the tearing in passing briery bushes, become thin and short, and lack the flowing abundance which pleases us in the caged animal. Like the tiger, the lion destroys cattle, but seldom or never eats men.

The panther and leopard in many things resemble the tiger; they seldom attack man, unless they are provoked, driven into a corner, or wounded, when, like all cat-like animals, they become very dangerous. Occasionally, though fortunately rarely, cases are reported when both animals show an unusual ferocity, and become man-eaters. For many experienced Europeans, and even for the native hunter, the Central Asiatic panther, a large, powerful beast, is far more dangerous than even the royal tiger, and both panther and leopard climb with agility, a power fortunately denied tigers and lions. Only a few years ago, it was reported that an English officer and a native hunter fired at a panther from the top of a tree, and wounded him severely. The panther climbed the tree, dragged the unfortunate Englishman down, mutilated him so that he died shortly after, and then mounted the tree again, and killed the hunter.

The panther, like the tiger, preys upon cattle; the leopard especially troubles the sheep and goats of the villagers, and often takes up his station only a few hundred feet from the village. Especially since the Indian mutiny, when the country was disarmed, and in mountainous regions, leopards have increased to an unusual degree. Formerly each village possessed two or three guns; now only certain people obtain permission of the government to carry arms, and consequently not enough animals are killed. The leopard has special designs against dogs, which he carries off zealously; often he will not attack a strong dog, but creeps up to him unnoticed and waits for a favorable opportunity to seize him, and to leap upon his neck, when he seldom looses his hold until the strength of the victim is exhausted. Notwithstanding the iron collar furnished with points which these valuable dogs wear, they are often


LEWIS ENG. Co. BOSTON

carried off by the leopards in the valleys of the Himalaya.

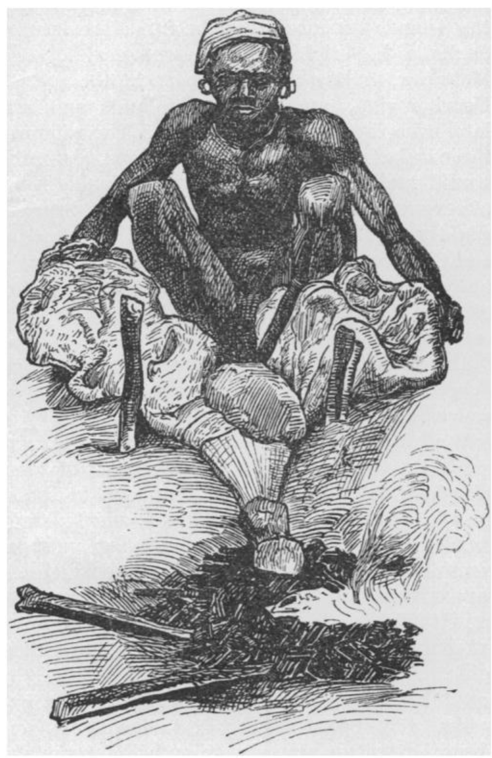
Among Indian beasts of prey there are three kinds of bears; two of them, the brown and black Himalaya bears, are found only in the mountains of northern India. The third kind, Ursus labiatus, is found only on the plains or in the lower mountain-passes, as in the Neilgherries of Madras. This last is not a flesh eater, but lives principally on wild fruit, various roots, grain, ants and honey. The two mountain bears, on the contrary, are undoubtedly beasts of prey and kill and consume as opportunity offers, sheep, goats and cows, a large number of cases occurring every year. Woodmen are often brought home frightfully torn and mangled, and at times cases are reported when a bear has attacked a man without the least provocation. A she-bear wlth young is more eager than any other animal to keep men from the neighborhood of her young; she will furiously attack any one who approaches them, and will pursue him, and wound him seriously with her teeth and claws; but a case has never been heard of, although often mentioned in books, where she engaged in close combat and attempted to crush her victim in her strong embrace. Indian bears are especially night animals, but they are frequently met with in the daytime, especially during the rainy season when the grass and jungles are thick and overgrown. At these times, and in distant places, where the forests are little travelled, one may easily come across the black bear seeking acorns under clusters of oaks, or bending down boughs to obtain the fruit, and it is not at all rare to see a bear trotting toward one in the open highway. But if he is only left alone, as a rule he will seldom trouble a man.

To complete the record another four-footed animal must be mentioned, namely, the bheria or Indian wolf, to which many men and animals fall victims. There is something especially abominable in his character, for he scarcely ever ventures on a man or woman, but makes children his prey. In some of the northern provinces of India, especially in Oude, and in some parts of Rohilcund, and also in the whole northwestern province of Bengal, the loss of human life by the wolf is very great. While the larger cat-like animals, as the tiger, lion, panther, and leopard, are night animals, the wolf, belonging to the dog tribe, is a day robber. At night he carries off little children from their beds, or from the side of their parents, if they sleep in the open air. The natives state that if a wolf has once tasted human flesh, he afterwards specially desires it, and touches almost no other food. A wolf usually lies in ambush in the immediate neighborhood of a village, in a corn-field, or in a strip of sugar-cane, and here bides his time, and watches a company of naked children at play, until by chance one of them gets separated a little from his playmates and approaches the wolf. Then a sudden shriek is heard, and a brown object is seen fleeing in all haste; very rarely can such a child be saved, for the wolf generally strangles it long before help can be rendered. According to the natives, the Indian wolf is so sly and cautious that he is never caught either in ditches or in traps.

AN AFRICAN SMITHY.

IN his account in the London *Graphic* of his journey to Kilima-njaro, Mr. H. H. Johnston describes a native forge:—

The Ma-Chaga are clever smiths, and forge all kinds of utensils, weapons and ornaments from the pig-iron they receive from the country of Usanga,



AN AFRICAN FORGE.

near Lake Jipé. The forge is but a pair of goat-skin bellows, converging into a hollow cone of wood, to which are added two more segments of stone, pierced through the centre, and ending in a stone nozzle, which is thrust into the furnace of charcoal. The bellows are kept steady by several

pegs thrust into the ground, and a huge stone is often placed on the pipe to keep it firm. After the iron has been heated white hot in the charcoal, it is taken out by the iron pincers and beaten on a stone anvil. The Chaga smiths not only make spear-blades and knives of apparently tempered steel, but can fabricate the finest and most delicate chains.

THE INDUSTRIES OF SIBERIA.[1]

IN the region of the Amoor, the industries are of very small extent, chiefly on account of lack of means of transportation. The only possible communication at present is upon the rivers, and is completely closed during a great part of the year, when the rivers are impassable for both boats and sledges. This is unfortunate, for on the borders of this immense territory lie important industrial interests.

At the sources of the tributaries of the Amoor are gold mines; Kamchatka and the neighboring islands produce valuable furs; the island of Saghalin has rich and excellent coal deposits. Moreover, in the southern part, in the so-called Usuri region, are rich timber-lands and some land even capable of cultivation. The pursuit of these industries, with the fisheries and coal-mines, would make this Usuri region a valuable source of revenue; at present, however, they are very slightly developed, and that mostly by Americans and Chinese, rather than by Russians. The latter, however, are making strenuous exertions to colonize the territory, and thus avail themselves of its resources.

The industries of the two western provinces, Tobolsk and Tomsk, are somewhat farther advanced; these two provinces contain over 80 per cent of all the manufactories of Siberia. According to the official reports there are 2,300 of these, of which 1,460 are in Tobolsk and 660 in Tomsk. In all 12,500 hands are employed, and 14,000,000 roubles value produced annually. The most important class of manufactures is that which uses raw animal materials,—dyeing and tallow rendering establishments, etc. The class next in importance includes the distilleries, breweries and flour-mills. Besides these there are numerous soap, candle and glue factories, carriage factories, rope walks, felt-boot making establishments, etc. These latter can scarcely be called factories, but are rather of the nature of small work-shops. Except the mines and the smelting works closely connected with them, there is very little manufacture of mineral products in Siberia. There is one exception in the case of considerable glass works, which produce 200,000 roubles worth annually. There are also small potteries and brick kilns. The only textile manufacturing worthy of notice is done at a single establishment in Tjumen, which produces annually 200,000 roubles worth of army cloth. The needs of the people in this line are almost entirely supplied by household manufactures. Many knit and woven woollen articles prepared in this way find a market even in European Russia.

In all the Siberian manufactures, there is almost no national division of labor or management of capital. The same person is often both capitalist and laborer, and the production of the raw materials goes hand in hand with the manufactures. The manufactories are distributed here and there about the country, where the raw material is to be had to the best advantage, for transportation is difficult and costly.

Many products, even those which have a wide demand, produce a bad impression on account of their clumsiness and tasteless execution. The low standard of living and education among the peasants, who are the principal customers, is the main cause of this. For instance, in a town of Tobolsk are produced coarse, clumsy muskets with flint locks, which, nevertheless, find a ready sale at a good price, even as far as East Siberia and Amoor.

In general, however, manufacturing has taken many steps in advance in Siberia within the last fifteen years. In many places machinery has taken the place of hand labor, better processes in tanning, dyeing, etc., have been introduced, and a general improvement is noticeable in the quality of all the the productions. With better means of transportation and an infusion of European enterprise, Siberia will yet contribute an important share to the resources of the world.

[1]Condensed from an article in the *Oesterreichische monatschrift für den Orient.*

— According to the Indian papers Dr. Aitchison has made an extensive botanical collection in Badghis and Khorassan, in Persia, and when last heard of was at Turbat, on the Perso-Afghan frontier. He is said to be very anxious to transfer his collections, which number 600 species, to Kew. His researches have been directed, not merely to the collection of plants, but to ascertaining the uses to which they are put locally.

— The rapidity with which stalactites are formed under favorable condition is well shown in St. John's Gate, Quebec. This old gate in the walls of the city was rebuilt in 1867 of a greyish limestone, and the constant dripping of water from the crevices has made deposits of rather dirty limey matter. In many cases regular stalactites have been formed, some reaching a length of a foot and a half, and being at least three-quarters of an inch in diameter at the base.